indicate that secondary digestive phenomena may take place in it. The reaction of the contents is neutral or alkaline.

The second, wider portion of the terminal intestine only performs the function of a stercoral reservoir. It is associated, for example in the Dytiscidæ, the *Nepæ*, and the *Ranatræ*, with a voluminous cæcum, which is not a natatory bladder as has been supposed. It may be empty or full of liquid, but never contains any gas. The liquid product secreted by the Malpighian tubes accumulates there, and, under certain circumstances, deposits in it calculi which may be of considerable size.

Some substances resist the digestive action and are passed with the excrements. Such are the chitine of the integuments of insects, vegetable cellulose, and chlorophyl; the microspectroscope enables us to detect the last at all parts of the alimentary tube of herbivorous insects.

Insects have nothing resembling the chyliferous ducts. The products of digestion, dissolved salts, peptones, sugar in solution, and fatty emulsions, traverse the comparatively thin coats of the digestive tube by a phenomenon of osmosis, and mix with the blood outside this tube.

The Malpighian tubes are exclusively depuratory and urinary organs, which free the body from the products of the wear of organic elements. The liquid that they secrete contains urea (doubtful), uric acid, urates in abundance, hippuric acid (doubtful), chloride of sodium, phosphates, carbonate of lime, oxalate of lime in quantity, leucine, and colouring-matters.

As to the so-called *anal glands*, the product they secrete is very variable in different groups; but it has no part to play in digestion, and is not urinary.

On the Structure and the Development of the Sting and Ovipositor of some Hymenoptera and of Locusta viridissima. By Dr. H. Dewitz.

It has generally been admitted, until within the last few years, that the parts which are found at the posterior extremity of the bodies of insects, and which constitute nippers, cerci, the ovipositor, and the sting, are formed by the transformation of certain segments, or at least of some arches of segments. However, new views as to the origin and signification of these organs were introduced into science in 1866 by Packard and Weissmann. Memoirs directly or indirectly relating to this subject have been published more recently by Ganin in 1869, and lastly by Oulianin and Kräpelin in 1872 and 1873.

The embrylogical researches of M. Dewitz, which relate to *Locusta viridissima*, *Apis mellifica*, *Bombus* sp., *Vespa vulgaris*, and *Cryptus migrator*, have led him to the discovery of some important facts, which confirm, in a general way, the opinion of the anatomists whom we have just mentioned, completing and rectifying certain points of their observations. To give an idea of the results

at which the author has arrived we think we cannot do better than translate the most essential part of the summary which terminates his memoir.

"In all the insects observed, the body is composed of thirteen segments behind the head. Nevertheless this number presents in the Hymenoptera an apparent reduction, arising from the invagination of the last segment; while in the *Locustæ* there seems to exist, on the contrary, one segment more than usual, because, in the course of development, the last segment divides into two parts—namely, a posterior anal piece and an anterior annular piece*.

"Both the sting and the ovipositor are formed of six principal parts, of which, however, the number is reduced to five in the Hymenoptera which the auther has been able to observe, in consequence of the soldering together of two of them. These six parts originate from six papillæ, four of which belong to the penultimate segment (12th behind the head) and two to the antepenultimate. These papillæ originate from disks (*Imaginalscheiben*) similar to those which Weissmann has described in connexion with the formation of the appendages of *Corethra*; but while in the Hymenoptera observed these disks originate from an invagination of the hypoderm, which thrusts itself into the cavity of the body in the shape of hollow demispheres, we can recognize in *Locusta* only a thickening and projection of the hypoderm exteriorly. The time of the appearance of the six papillæ is not the same in all cases: in the bees, at the commencement of the larval period the two papillæ of the antepenultimate segment and the two intermediate ones of the penultimate appear simultaneously, while the two lateral papillæ of the latter do not show themselves until later; on the other hand, in the grasshoppers, while still in the egg the two lateral papillæ of the penultimate segment are already very much advanced in development, the two of the antepenultimate segment are indicated in the form of disks; and the two intermediate ones of the penultimate segment appear only when the animal has quitted the egg for some time. We consequently see here, as in other cases of the development of the Articulata, that homologous parts do not always appear in the same order, but show themselves sooner or later according to the dimensions which they have to acquire or the importance which they will have in the sequel.

"In the Hymenoptera observed, the sheaths result from the development of the two lateral papillæ of the penultimate segment, the

* M. H. de Saussure, who has carefully studied the abdomen of the adult Orthoptera, has only found nine segments in these latter insects, besides the intermediate segment, which has no ventral arch and belongs rather to the thorax than to the abdomen. The body, therefore, would possess, according to him, thirteen segments without counting the head (see 'Mémoires pour servir à l'Histoire Naturelle du Mexique &c.,' tome i. p. 263, and 'Mission scientifique au Mexique &c.,' Orthoptères, p. 2, pl. i.). In the Hymenoptera the intermediate segment closes the thorax behind, and forms that which has been wrongly called the metathorax. It is then entirely separated from the thorax.

channel from the development of the intermediate papillæ of this same segment, and the bristles serving to sting or to perforate proceed from the two papillæ of the antepenultimate. As the parts of the ovipositor in *Locusta* have the same origin, we ought to consider them homologous with the parts of the sting of the Hymenoptera; and the upper sheaths of the grasshopper consequently correspond to the sheaths of the sting, the lower ones to the piercing-setæ, and the annexed sheaths to the channel.

"The segments take part in the formation of the sting only inasmuch as the chitinous bands forming in the parts of the sting are attached to them and partly soldered to them. Some particular points of the surface of the segment also present a stronger deposit of chitine, and thus attach themselves to parts of the sting; this is the case with the flattened plates and the angle (*Winkel*) of the Hymenoptera, as well as with some of the pieces which occur at the base of the ovipositor in *Locusta*, and which have not yet received a name.

"The sting is distinguished in a remarkable manner from the ovipositor of the grasshoppers by the number as well as by the attachment of the muscles which move these apparatus.

"In *Apis* &c. these last are fixed only on the anterior part of the sting, which is inserted into the body; while in *Locusta* they penetrate also into the pieces of the ovipositor. However, the differences arise above all from the dimensions, the forms, and the adherences of homologous parts, and particularly from the different relations which the sheaths of the sting and the upper sheaths in *Locusta* bear to the other parts. The setæ of the Hymenoptera and the lower sheaths of *Locusta* present very different forms; the former have only one groove, the latter have two. The appendages which in the Hymenoptera form the channel, undergo in *Locusta* an arrest of development.

"The cheliform and foliaceous appendages which constitute the external copulatory organs of the males of the bees and Ichneumonidæ, as well as the two styliform appendages of the anal piece of the penultimate segment in the males of the grasshoppers, originate from two papillæ situated on the penultimate segment.

"Embryogeny therefore teaches us that the parts of the sting and of the ovipositor represent appendicular organs. It only remains to inquire if we ought to regard the four appendages of the penultimate segment as representing two pairs of members, or as two members having undergone a longitudinal division. This latter interpretation is preferable, since each group of two appendages arises from one disk only, which proves its unity. However, to decide this question with certainty, we must have more numerous observations than we possess up to the present time on the formation of the appendages of articulated animals."—*Zeitschr. für wiss. Zool.* Band xxv. 1875, pp. 174–200; *Bibl. Univ.* April 15, 1875, *Arch. des Sci.* p. 343.